PATENT COOPERATION TREATY

REC'D 04 SEP 2006

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From the
INTERNATIONAL SEARCHING AUTHORITY

To:
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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing (*day/month/year*)	31 AUG 2006
Applicant's or agent's file reference 0401PCT-BIOD	FOR FURTHER ACTION See paragraph 2 below

International application No.	International filing date (*day/month/year*)	Priority date (*day/month/year*)
PCT/US04/12546	22 April 2004 (22.04.2004)	

International Patent Classification (IPC) or both national classification and IPC

IPC(7): G01N 11/10 and US Cl.: 73/32R, 32A,54.24-54.26, 54.32, 54.34, 54.41; 310/313R, 313A

Applicant

ANDLE, JEFFREY C.

CORRECTED VERSION

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [x] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [x] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(*b*) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230	Hezron Williams Telephone No. 571-272-

Form PCT/ISA/237 (cover sheet) (January 2004)

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Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This opinion has been established on the basis of a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material

   ☐ in written format

   ☐ in computer readable form

   c. time of filing/furnishing

   ☐ contained in international application as filed.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

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Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has:
   - ☒ paid additional fees
   - ☐ paid additional fees under protest
   - ☐ not paid additional fees
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
   - ☐ complied with
   - ☒ not complied with for the following reasons:

   See the lack of unity section of the International Search Report(Form PCT/ISA/210)

4. Consequently, this opinion has been established in respect of the following parts of the international application:
   - ☒ all parts.
   - ☐ the parts relating to claims Nos. _____

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Box No. V Reasoned statement under Rule 43 *bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-8, 10-49	YES
	Claims	9, 50, AND 52-54	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-65	NO
Industrial applicability (IA)	Claims	NONE	YES
	Claims	NONE	NO

2. Citations and explanations:

Please See Continuation Sheet

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Supplemental Box
In case the space in any of the preceding boxes is not sufficient.

V. 2. Citations and Explanations:

1. Claims 1-8, and 10-49, 51, and 55- 65 lack inventive step under PCT Article 33(3) as being obvious over Herrmann et al. (6,543,274) in view of Yen et al. (4,513,261).

Re claims 1, 6, and 16, as depicted in figs. 1 and 4, Herrmann et al. discloses an entrapment layer (e.g., liquid traps 17) having a textured surface in contact with a fluid, and having a known volume available for entrapping the fluid. Herrmann et al. discloses LPAWD comprising an input ant output transducers (6a, 6b) electronically coupled to the respective first and second resonators (e.g., reflector banks 14). Herrmann et al. discloses measuring the density and viscosity of the fluid. Herrmann et al. lacks the detail of providing the LPAWD with an electrical transfer function characterized by at least a first resonant frequency Fs and a second resonant frequency FA at or about 180 degrees phase shift relative to the Fs. As depicted in fig. 1 Yen et al. discloses a first resonant frequency Fs second resonant frequency FA at or about 180 degrees phase shift relative to the Fs (Col. 3, lines 45-68). Therefore, to modify Herrmann et al. by employing an electrical transfer function characterized by a second resonant frequency that is about 180 degrees phase shift relative to the first resonant frequency would have been obvious to one of ordinary skill in the art at the time of the invention since Yen et al. teaches acoustic filter having theses design characteristics. The skilled artisan would be motivated to combine the teachings of Herrmann et al. and Yen et al. since Herrmann et al. states that his invention is applicable to determining density of a fluid including an two-port resonator/filter and Yen et al. is directed to acoustic filter.

Re claim 2, Herrmann et al. discloses calculating the density of the fluid.

Re claim 3, as depicted in fig. 1, Herrmann et al. discloses a textured surface (e.g. liquid traps 17) cover an approximately equal area of each of the resonators (e.g., reflector banks 14).

Re claim 4, Herrmann et al. discloses a calibration function to account for an approximated viscosity of the fluid (Col. 6, lines 24-32).

Re claim 5, as depicted in fig. 5, Herrmann et al. discloses a two-port resonator. Herrmann et al. does not discloses providing an amplifier coupled between the input and output transducers. Yen et al. discloses a phase shift circuit (24), which inherently includes an amplifier (Col. 5, line 4). Therefore, to modify Herrmann et al. by employing an amplifier would have been obvious to one of ordinary skill in the art at the time of the invention since Yen et al. teaches acoustic filter having theses design characteristics. The skilled artisan would be motivated to combine the teachings of Herrmann et al. and Yen et al. since Herrmann et al. states that his invention is applicable to determining density of a fluid including an two-port resonator/filter and Yen et al. is directed to acoustic filter.

Re claim 7, Herrmann et al. discloses an input signal is controlled to produce a predetermined shear rate under which viscosity is measured.

Re claim 8, Herrmann et al. discloses a shear rate that is controlled by controlling the input electrical signal at an energy level to produce a desired displacement of the entrapment layer (e.g., liquid traps 17).

Re claim 10, Herrmann et al. discloses measuring the power difference between the input and output transducers (Col. 6, lines 24-51).

Re claim 11, Herrmann et al. discloses measuring a second resonant frequency (6, lines 12-24).

Re claim 12, as depicted in fig. 1, Herrmann et al. discloses a textured surface (e.g. liquid traps 17) cover an approximately equal area of each of the resonators (e.g., reflector banks 14).

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Re claim 13, Herrmann et al. discloses measuring the viscosity by utilizing the measured density of the product.

Re claim 14, Herrmann et al. discloses using the measured viscosity to compensate for viscosity effects in the step of measuring density (Col. 6, lines 24-32).

Re claims 15 and 17, Herrmann et al. discloses measuring two frequencies (f1 and f2). Herrmann et al. discloses does not specifically discloses measuring the insertion loss between the input and output resonator. As depicted in fig. 1, Yen et al. discloses measuring the insertion loss between the input and output resonator. Therefore, to modify Herrmann et al. by employing power insertion loss between the input and output transducer would have been obvious to one of ordinary skill in the art at the time of the invention since Yen et al. teaches acoustic filter having theses design characteristics. The skilled artisan would be motivated to combine the teachings of Herrmann et al. and Yen et al. since Herrmann et al. states that his invention is applicable to determining density of a fluid including an two-port resonator/filter and Yen et al. is directed to acoustic filter.

Re claims 18, 19, 33, and 34, Herrmann et al. discloses measuring two frequencies (f1 and f2) or a two-port resonator. As depicted in figs. 1, 6, and 8, Herrmann et al. discloses an entrapment layer (e.g., liquid traps 17) coupled to a substrate (5) by an intermediate layer (21). Herrmann et al. discloses does not discloses that the an electrical transfer function characterized by at least a first resonant frequency Fs and a second resonant frequency FA at or about 180 phase shift relative to the Fs. As depicted in fig. 1 Yen et al. discloses a first resonant frequency Fs second resonant frequency FA at or about 180 degrees phase shift relative to the Fs (Col. 3, lines 45-68). Therefore, to modify Herrmann et al. by employing an electrical transfer function characterized by a second resonant frequency that is about 180 degrees phase shift relative to the first resonant frequency would have been obvious to one of ordinary skill in the art at the time of the invention since Yen et al. teaches acoustic filter having theses design characteristics. The skilled artisan would be motivated to combine the teachings of Herrmann et al. and Yen et al. since Herrmann et al. states that his invention is applicable to determining density of a fluid including an two-port resonator/filter and Yen et al. is directed to acoustic filter.

Re claims 20 and 35, as depicted in fig. 1, Herrmann et al. discloses the entrapment layer (e.g., liquid traps 17) are composed of at least one face having grooves formed thereupon, for trapping a known volume of fluid.

Re claims 21, 22,36, and 37, as depicted in figs, 1, and 6-8, Herrmann et al. discloses grooves formed by depositing material on the face to form ridges. Re to the further limitation of claims 22 and 37, Herrmann et al. discloses the grooves are perpendicular to the wave motion in the substrate (5).

Re claims 23 and 38, as depicted in fig. 1, and 6, Herrmann et al. discloses the grooves are dimensioned to be smaller than the length of a quarter of wavelengths in the liquid.

Re claims 24 and 39, as depicted in fig.1 and 6, Herrmann et al. discloses the entrapment layer (e.g., liquid traps 17) comprises at least one chamber formed therein, and the chamber having at least one opening for entrapping a known volume of fluid.

Re claims 25 and 40, as depicted in fig.1 and 6, Herrmann et al. discloses the chamber is cut into a face of the entrapment layer.

Re claims 26 and 4, as depicted in fig.1 and 6, Herrmann et al. discloses the chamber is formed by material deposited on to the entrapment layer.

Re claims 27 and 42, as depicted in fig.1 and 6, Herrmann et al. discloses the entrapment layer (e.g., liquid traps 17) is integral to at least one face of the substrate.

Re claims 28 and 43, as depicted in fig.1 and 6, Herrmann et al. discloses the entrapment layer comprises at least a textured surface for entrapment of a known volume of liquid.

Re claims 29 and 45, as depicted in fig. 1, Herrmann et al. discloses an entrapment layer (e.g. liquid traps 17) cover an approximately equal area of each of the resonators (e.g., reflector banks 14).

Re claims 30 and 46, as depicted in fig. 1, Herrmann et al. discloses an entrapment layer (e.g. liquid traps 17) covers at least 50% of the frontal area of each of the resonators (e.g., reflector banks 14).

Re claims 31 and 47, as depicted in fig. 1, Herrmann et al. discloses the entrapment layer comprises an area having a plurality of cavities.

Re claims 32 and 48, as depicted in fig. 1, Herrmann et al. discloses the area covers substantially a whole surface of at least one face of the entrapment area.

Re claims 44, as depicted in fig. 1 and 6, Herrmann et al. discloses the entrapment layer comprises at least one groove.

Re claim 49, as depicted in figs. 1 and 4, Herrmann et al. discloses an entrapment layer (e.g., liquid traps 17) coupled to a substrate. Herrmann et al. discloses input and output transducers (6a, 6b) electronically coupled to the respective first and second resonators (e.g., reflector banks 14). Herrmann et al. discloses measuring the density and viscosity of the fluid. Herrmann et al. lacks the detail of providing an electrical transfer function characterized by at least a first resonant frequency Fs and a second resonant frequency FA at or about 180 degrees phase shift relative to the Fs. As depicted in fig. 1 Yen et al. discloses a first resonant frequency Fs second resonant frequency FA at or about 180 degrees phase shift relative to the Fs (Col. 3, lines 45-68). Therefore, to modify Herrmann et al. by employing an electrical transfer function characterized by a second resonant frequency that is about 180 degrees phase shift relative to the first resonant frequency would have been obvious to one of ordinary skill in the art at the time of the invention since Yen et al. teaches acoustic filter having theses design characteristics. The skilled artisan would be motivated to combine the teachings of Herrmann et al. and Yen et al. since Herrmann et al. states that his invention is applicable to determining density of a fluid including an two-port resonator/filter and Yen et al. is directed to acoustic filter.

Re claim 51, as depicted in fig. 10, Herrmann et al. discloses a first measuring means comprising a frequency measurement.

Re claims 55 and 56, as depicted in fig. 1 and 6, Herrmann et al. discloses the entrapment layer comprises at least one

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Supplemental Box
In case the space in any of the preceding boxes is not sufficient.

groove.

Re claim 57, as depicted in figs, 1, and 6-8, Herrmann et al. discloses grooves formed by depositing material on the face to form ridges. Re to the further limitation of claims 22 and 37, Herrmann et al. discloses the grooves are perpendicular to the wave motion in the substrate (5).

Re claim 58, as depicted in figs. 1, 6 and 7, Herrmann et al. discloses the plurality of grooves etched into one face of the entrapment layer.

Re claim 59, as depicted in figs 1, and 6, Herrmann et al. discloses the entrapment layer on one face of the substrate.

Re claim 60, as depicted in figs. 1, 6, and 8, Herrmann et al. discloses an entrapment layer (e.g., liquid traps 17) coupled to a substrate (5) by an intermediate layer (21).

Re claim 61, as depicted in fig.1 and 6, Herrmann et al. discloses the entrapment layer (e.g., liquid traps 17) comprises at least one chamber.

Re claims 62-64, Herrmann et al. discloses a input and output transducers (6a, 6b) coupled to resonators (14), and detect the viscosity and density of a fluid. Herrmann et al. lacks the detail of the input energy being controlled to measure the viscosity of the fluid at varying shear rates, and controlling to provide a known displacement. As depicted in fig. 1, Yen et al. discloses controlling the input energy of an input transducer (10) via means of a phase shifter circuit (24), to provide a known displacement. Therefore, to modify Herrmann et al. by employing an input energy that is controlled would have been obvious to one of ordinary skill in the art at the time of the invention since Yen et al. teaches acoustic filter having theses design characteristics. The skilled artisan would be motivated to combine the teachings of Herrmann et al. and Yen et al. since Herrmann et al. states that his invention is applicable to determining density of a fluid including an two-port resonator/filter and Yen et al. is directed to acoustic filter.

Re claim 65, Herrmann et al. discloses a temperature sensor (e.g. temperature resistor 15) (Col. 4, lines 30-39).

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Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

The drawings are objected to under PCT Rule 66.2(a)(iii) as containing the following defect(s) in the form or content thereof: Reference number 750 (See fig. 7) is not in the specification.

The drawings are objected to under PCT Rule 66.2(a)(iii) as containing the following defect(s) in the form or content thereof: a computer is not disclosed in drawings..